

Status and Trends For a Suite of Key Diving Marine Bird Species Characteristic of Greater Puget Sound, As Examined by the Marine Bird Component, Puget Sound Ambient Monitoring Program (PSAMP)

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Abstract

Aerial surveys of marine birds were conducted by PSAMP annually from 1992 to 1999 during each winter and most summer survey windows, sampling nearly every portion of the inner marine waters of Washington State. Surveys were stratified by two depth strata: nearshore (<20m) and offshore (>20 m). These surveys annually covered approximately 15% to 19% of the nearshore and 4% to 6% of the offshore strata.

Density estimates from a subset of the PSAMP winter nearshore survey transects were compared with those from the nearly identical winter aerial survey transects conducted from 1979 to 1980 in the northern portion of greater Puget Sound during the Marine Ecosystem Analyses (MESA) program administered by National Oceanic and Atmospheric Administration (NOAA) and funded by U.S. Environmental Protection Agency (EPA). Trends in changing densities over the last 20 years are examined for 18 species or species groups: scoters, scaups, goldeneyes, bufflehead, oldsquaw, harlequin ducks, mergansers, all loons combined, common loon, western grebe, red-necked grebe, horned grebe, all cormorants combined, double-crested cormorant, brant, all gulls combined, pigeon guillemot, and marbled murrelet. The results include a mixture of changes that range from significant decreases (grebes, cormorants, loons, pigeon guillemot, marbled murrelets, scoters, scarp, oldsquaw, and brant) to stable or more slowly decreasing patterns (goldeneyes, buffleheads, and gulls) or increasing patterns (harlequin ducks and probably mergansers).

Introduction and Objectives

The original contract design for the monitoring of marine birds by PSAMP included creation of a digital database which translated the MESA survey results, primarily density type data, into synthesis databases needed for comparison with recent monitoring. The MESA survey efforts did not utilize aerial surveys to the extent that PSAMP efforts have, but there is enough overlap geographically in nearshore areas to capture some picture of trends that have likely been occurring throughout western Washington marine waters for a variety of marine bird species. The comparison of nearly identical MESA and PSAMP aerial transects (Figure 1) offers us, in our judgment, the best opportunity to look over the longest time period available (20 years) that was measured by relatively comparable survey methodologies.

[Editor's note: All figures appear at the end of this paper.]

Methods

The aerial surveys are strip transects using standard methodologies from Alaska to California during the last 20 years. The aerial surveys compared in this exercise were conducted from generally two different types of planes: Cessna without floats in MESA work and De Havilland Beaver with floats in PSAMP. This means that the viewing area and angle is slightly different and the noise level is quite different. Each platform transect width was slightly different and the data has been weighted to account for this. The quieter Cessna might permit more of the small and more wary species like marbled murrelets and horned grebes to be observed, but larger species should have been observed similarly with either plane.

The comparisons of 54 nearshore transects shared by aerial surveys between 1978 and 1979 and 1992 through 1999 use only that part of the PSAMP survey effort that strictly mimicked the MESA transect effort in the Strait of Juan de Fuca, San Juan Islands, and northern inner marine waters of Washington

State. More discussion about these transects is included in the PSAMP bird component summary report on the 1992 to 2000 period (Nysewander and others 2001). Data was combined into two periods: the 1978 to 1979 MESA (N = 124) and 1992-1999 PSAMP (N = 414). Estimated mean densities were calculated for each period, weighting by sample unit areas. Differences between periods were tested by ANOVA. The comparisons we display in Figures 2 through 4 are based on the assumption that the MESA densities were likely average for that period.

Results

1. Waterfowl

The comparison of data from nearly identical aerial transects in both MESA and PSAMP monitoring depicts statistically significant decreases in densities for scoters ($P < 0.001$, 57.0 % decrease), scaup ($P < 0.001$, 72.3% decrease), and oldsquaw ($P < 0.001$, 91.0% decrease) while showing significant increases for harlequins ($P < 0.001$, 188.6% increase). The other three species of diving ducks examined did not have significance attached to their changes: goldeneyes ($P = 0.211$, 22.6% decrease), bufflehead ($P = 0.465$, 20.1% increase), and mergansers ($P = 0.065$, 55.3% increase). The MESA/PSAMP comparisons suggest that brant densities declined ($P = 0.03$, 66.3% decline).

2. Grebes and Loons

Western grebes appear to have declined even more so than diving duck species from levels seen twenty years ago ($P < 0.001$, 95% decrease). In fact, all the loon and grebe species examined have experienced marked decreases in the MESA/PSAMP comparisons: red-necked grebe ($P < 0.001$, 89% decrease), horned grebe ($P < 0.001$, 82% decrease), common loon ($P < 0.001$, 64 % decrease), or all loons combined ($P < 0.001$, 79% decrease).

3. Alcids

Comparisons are possible for both pigeon guillemots and marbled murrelets since they frequent nearshore depth strata in Washington State. Even though aerial surveys miss some of these, especially marbled murrelets, the comparisons of densities seen on aerial surveys in both MESA and PSAMP efforts suggest significant declines for these two species: pigeon guillemot ($P = 0.014$, 55% decline) and marbled murrelet ($P = 0.004$, 96% decrease).

4. Cormorants and Other Species

While wintering cormorant densities did not appear to change much during the PSAMP period, there have been significant decreases in densities between the MESA and PSAMP periods either for identified double-crested cormorants ($P = 0.001$, 62% decrease) or for all cormorants including the unidentified category ($P < 0.001$, 53% decrease). It is unknown whether cormorants return to similar wintering areas each winter. The inner marine waters of Washington State contain many other resident marine species as well as attracting many other wintering bird species, such as numerous gull species. The decrease in gull densities comes closest to significance ($P = 0.195$, 43.5% decrease).

5. Northern vs. Southern Distribution 1992-1999

The southern area (south and central Puget Sound) has contained both higher densities and higher overall numbers of either western grebes or scoters than those found to the north during the 1992 to 1999 PSAMP surveys, but comparisons during the PSAMP period do not capture any exchange of numbers between these regions for either species (Figures 5 and 6).

Conclusions

1. Definite changes in bird populations have been observed over the last 20 years in the varied marine bird species that winter in greater Puget Sound, including many significant declines in numbers and densities. It is uncertain whether documented changes relate to cycles of change like the North Pacific Decadal Oscillation or to more local changes in forage fish stocks.
2. Bird species that either eat fish or depend upon certain spawning events of Puget Sound forage fish appear to have declined more than species that emphasize feeding on other parts of the food chain like crustaceans and invertebrates.
3. The declines in scoters and scaup in Washington State have also been seen in other marine areas throughout the Pacific Flyway, suggesting that they have not moved from Washington to some other part of their wintering range. This aspect needs to be examined for other species that have declined, such as the western grebes.

Report Source for Poster

Nysewander, D. R., Evenson, J. R., Murphie, B. L., Cyra, T. A. 2001. Report of Marine Bird and Marine Mammal Component, Puget Sound Ambient Monitoring Program, for July 1992 to December 1999 Period. Agency Report, Washington Department of Fish and Wildlife, Olympia, WA, 161pp.

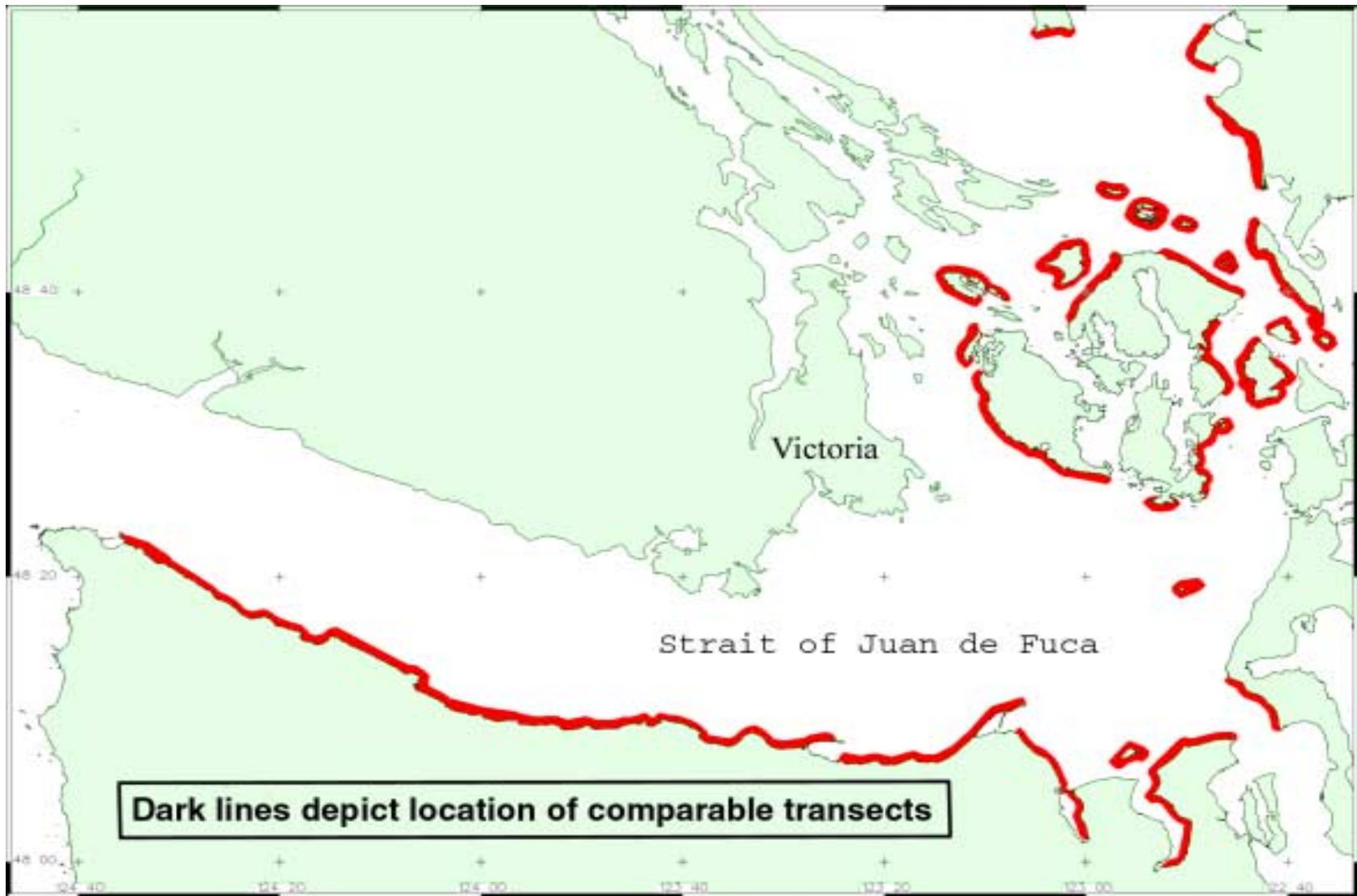


Figure 1. Transect Locations for Comparisons of Density Indices Derived from Aerial Surveys Conducted by both MESA and PSAMP Efforts.

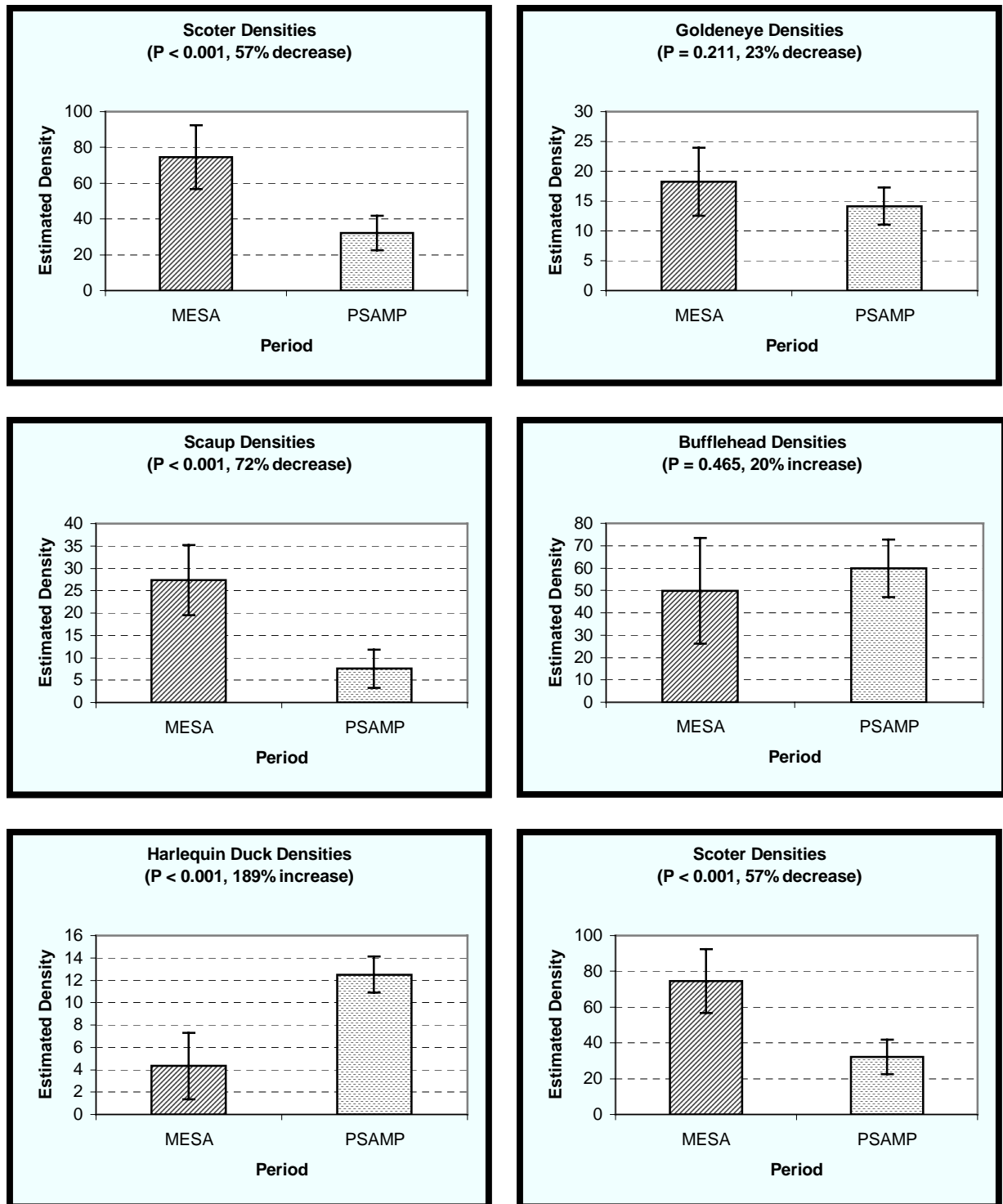


Figure 2. Changes in Density Indices (birds/km²) of Selected Diving Duck Species Observed on Nearly Identical Transects Between the 1978-79 MESA and the 1992-99 PSAMP Aerial Surveys.

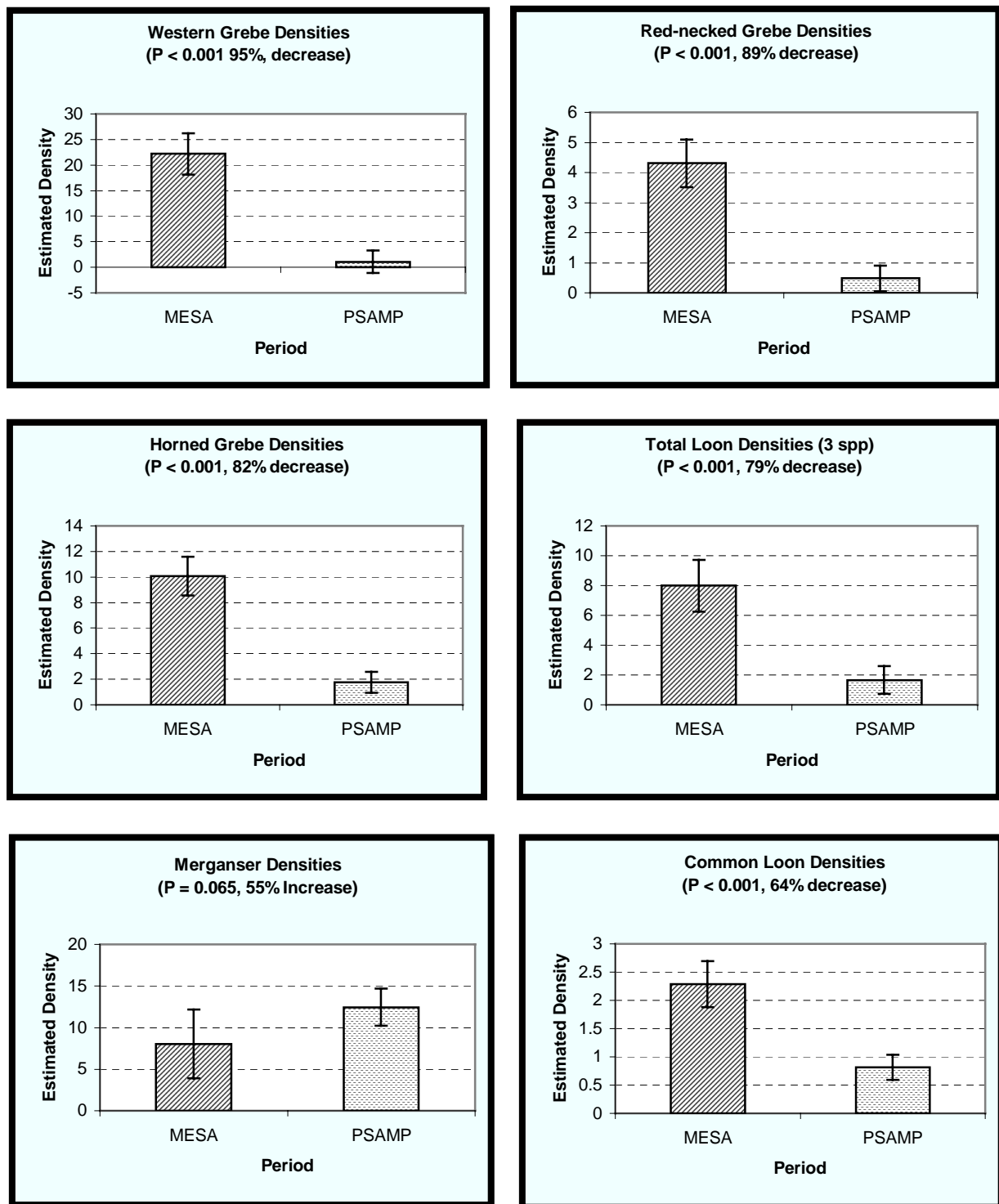


Figure 3. Changes in Density Indices (birds/km²) of Grebe, Loon, and Merganser Species Observed on Nearly Identical Transects Between the 1978-79 MESA and the 1992-99 PSAMP Aerial Surveys.

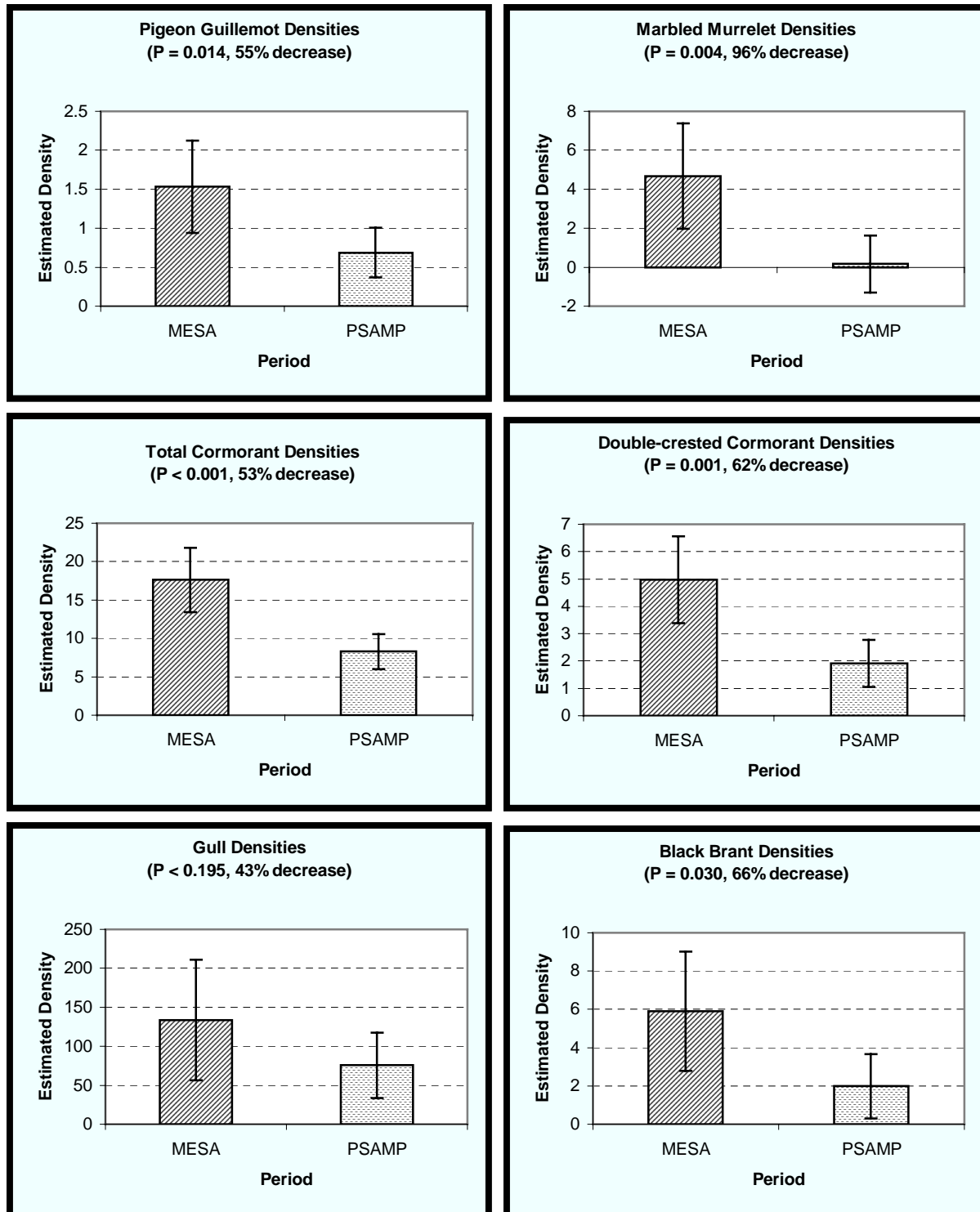


Figure 4. Changes in Density Indices (birds/km²) of Alcid, Cormorant, Gull, and Other Species Observed on Nearly Identical Transects Between the 1978 -79 MESA and the 1992-99 PSAMP Aerial Surveys.

Comparison of Northern and Southern Scoter Density Indices, 1993-2000 Winter Aerial Surveys

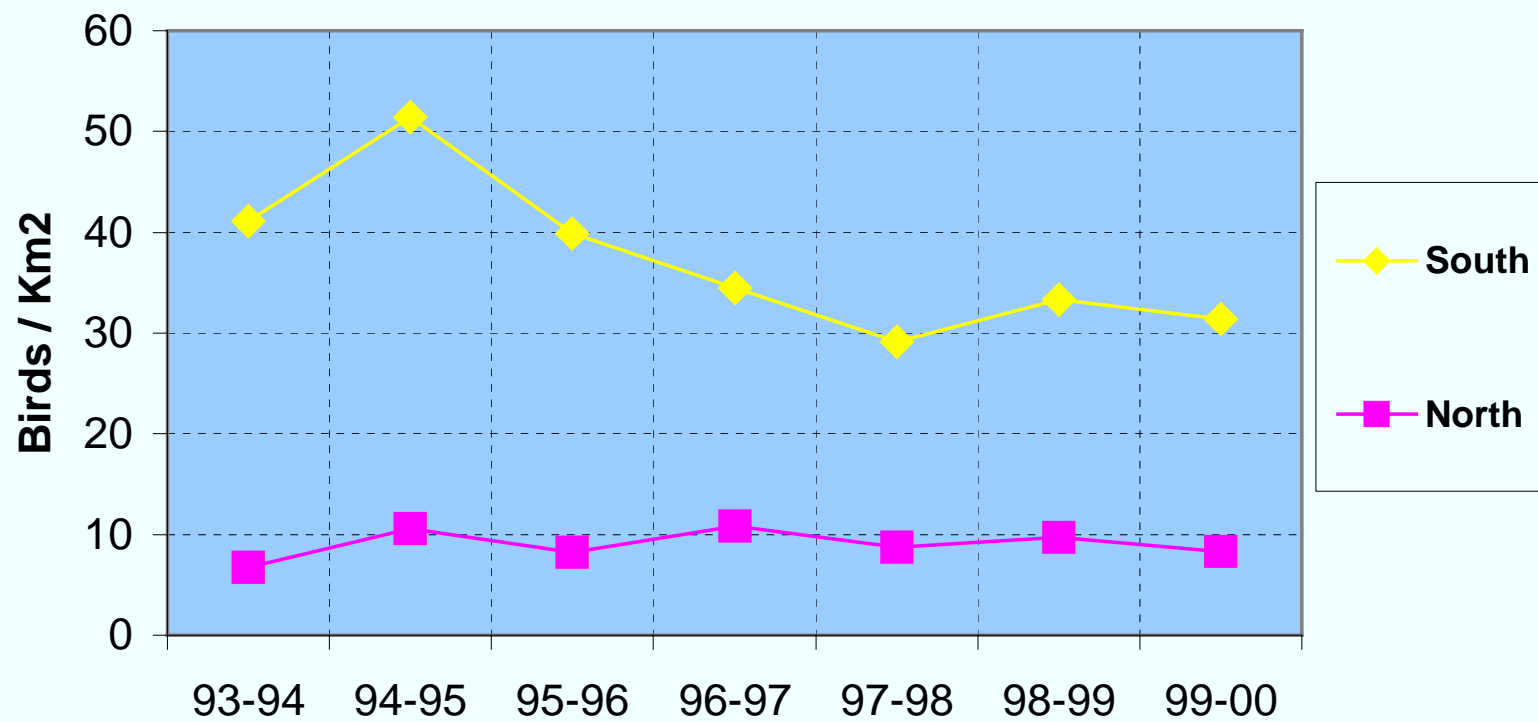


Figure 5. Comparison of Northern and Southern Scoter Density Indices, 1993-2000 PSAMP Winter Aerial Surveys.

Comparison of Northern and Southern Density Indices of Western Grebes, 1993-2000 Winter Aerial Surveys

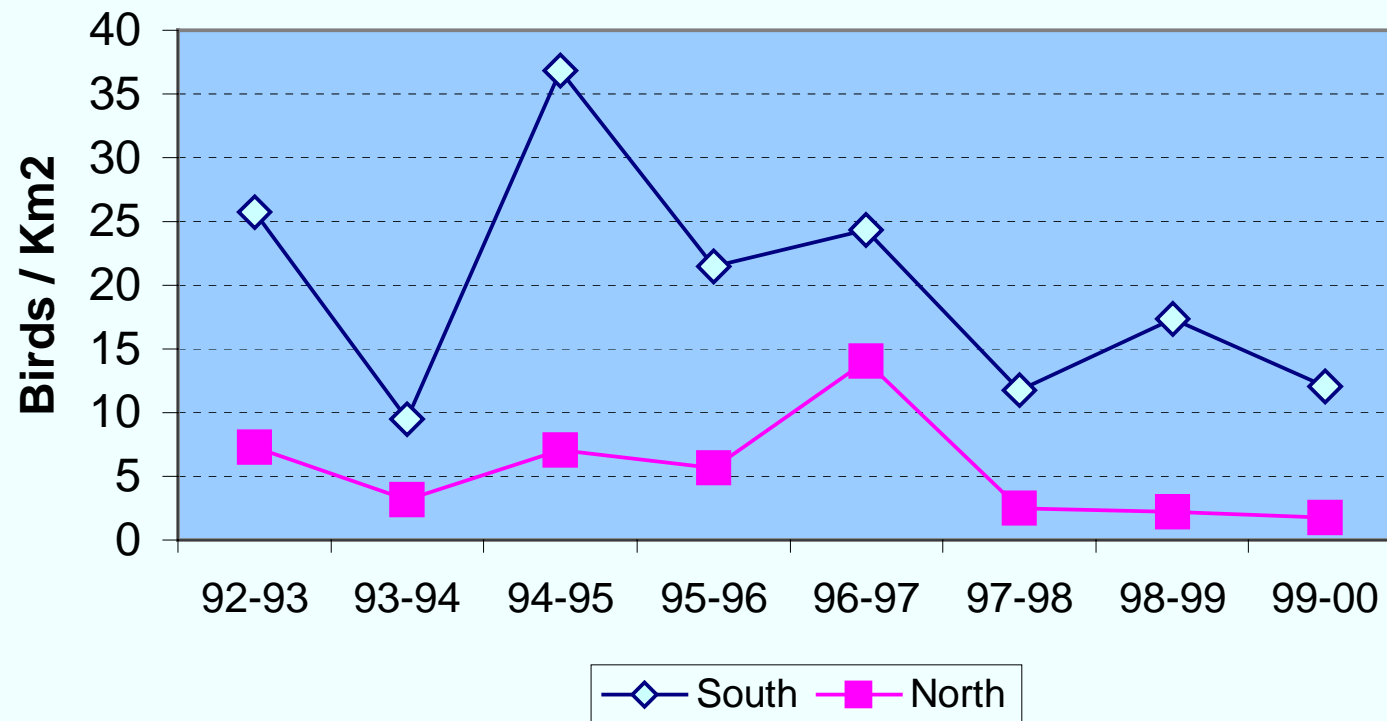


Figure 6. Comparison of Northern and Southern Density Indices Observed for Western Grebes, 1993-2000 PSAMP Winter Aerial Surveys.